New modeling tools for Ocean Acidification and Harmful Algal Blooms on the Washington Coast

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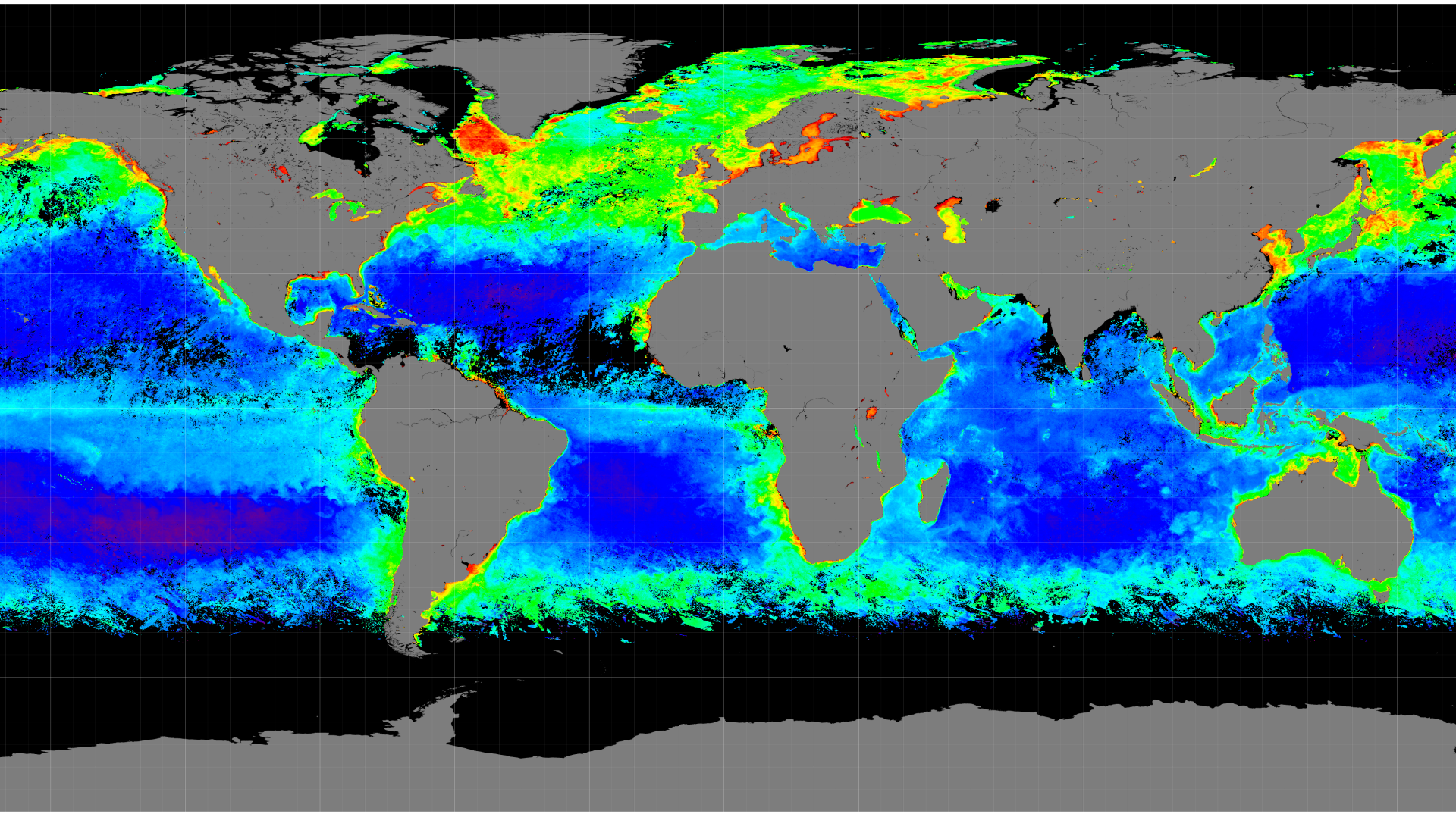
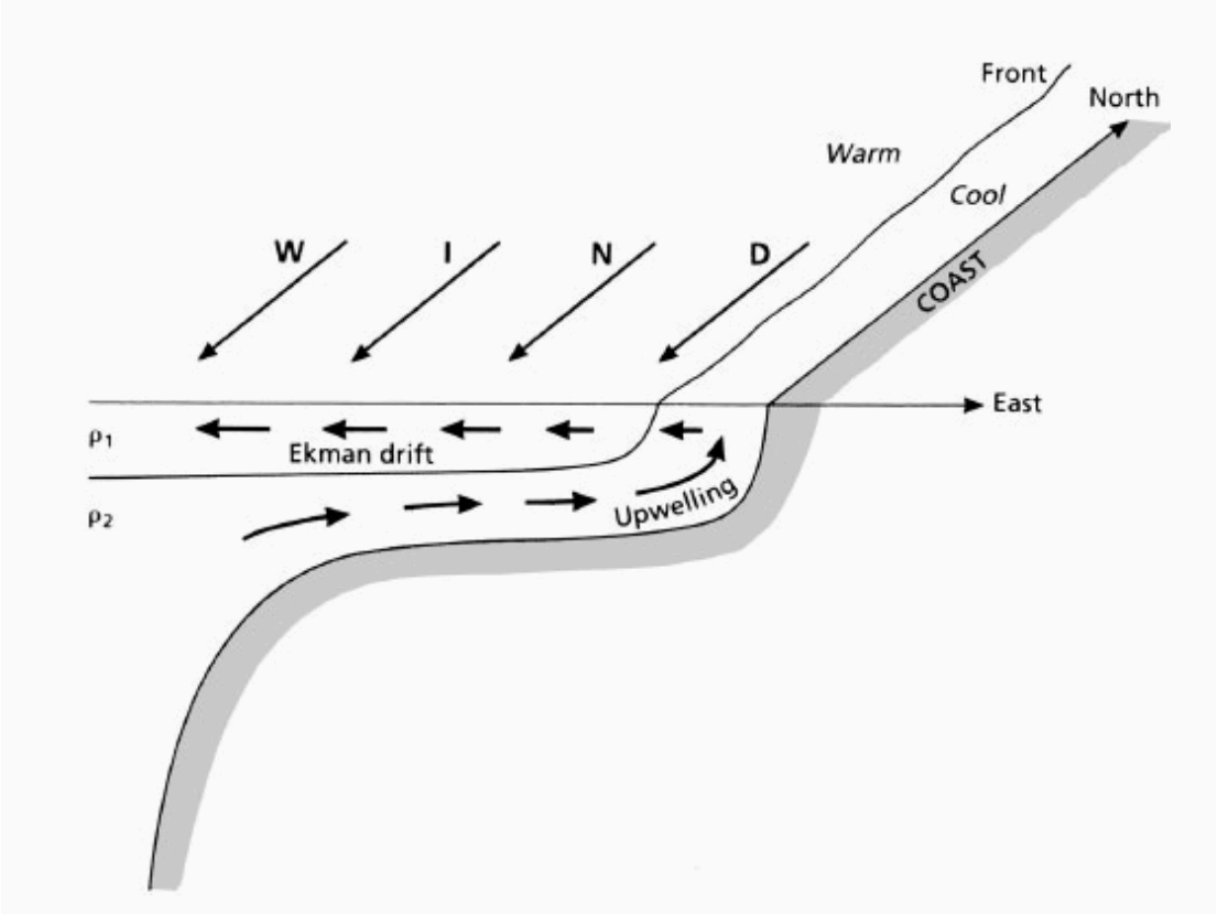
UW Coastal Modeling Group

Satellite Chlorophyll MODIS May 2015 [mg m^{-3}]

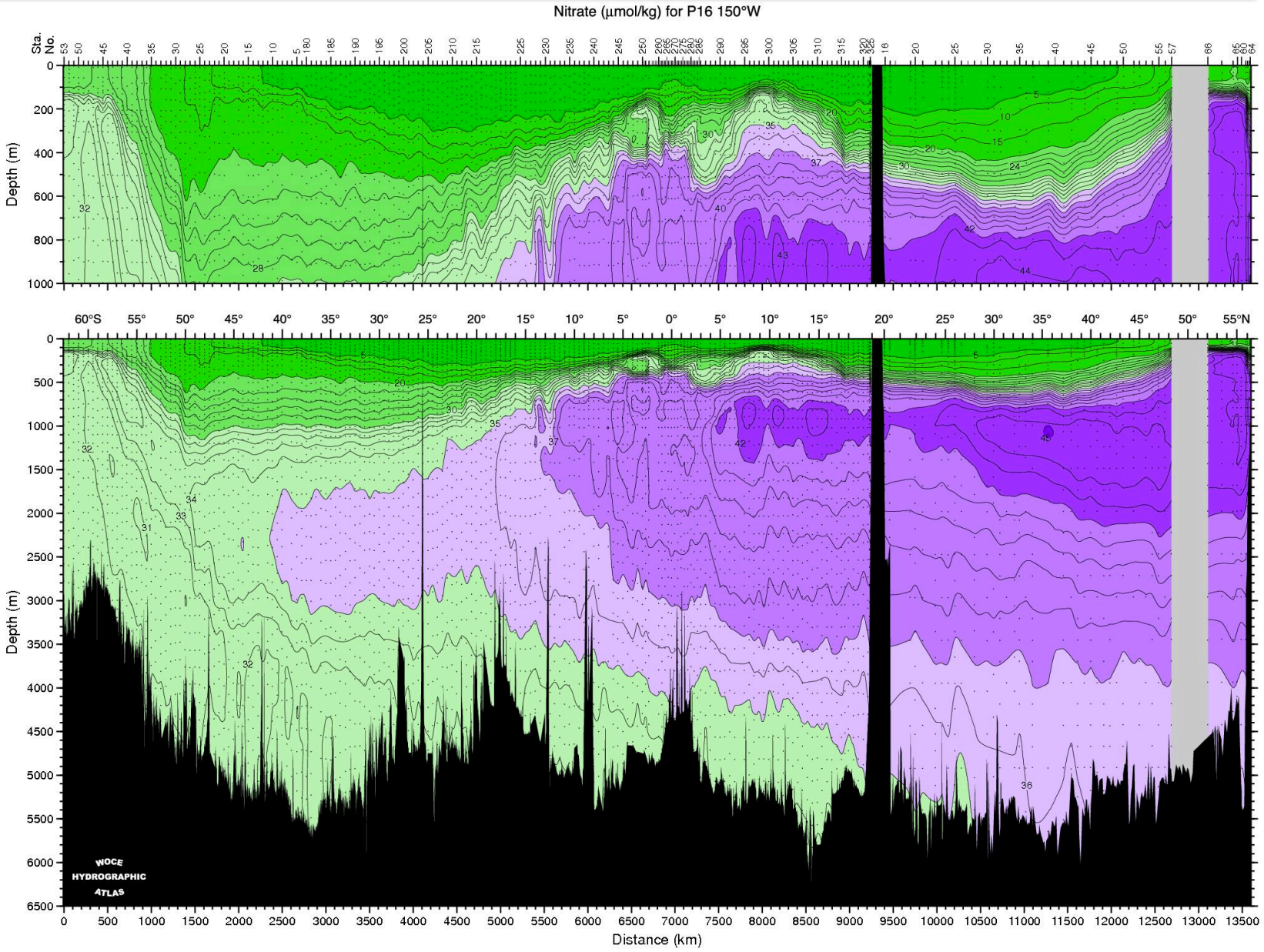


The coastal ocean is the location of about half of the global ocean primary production and fish harvest.

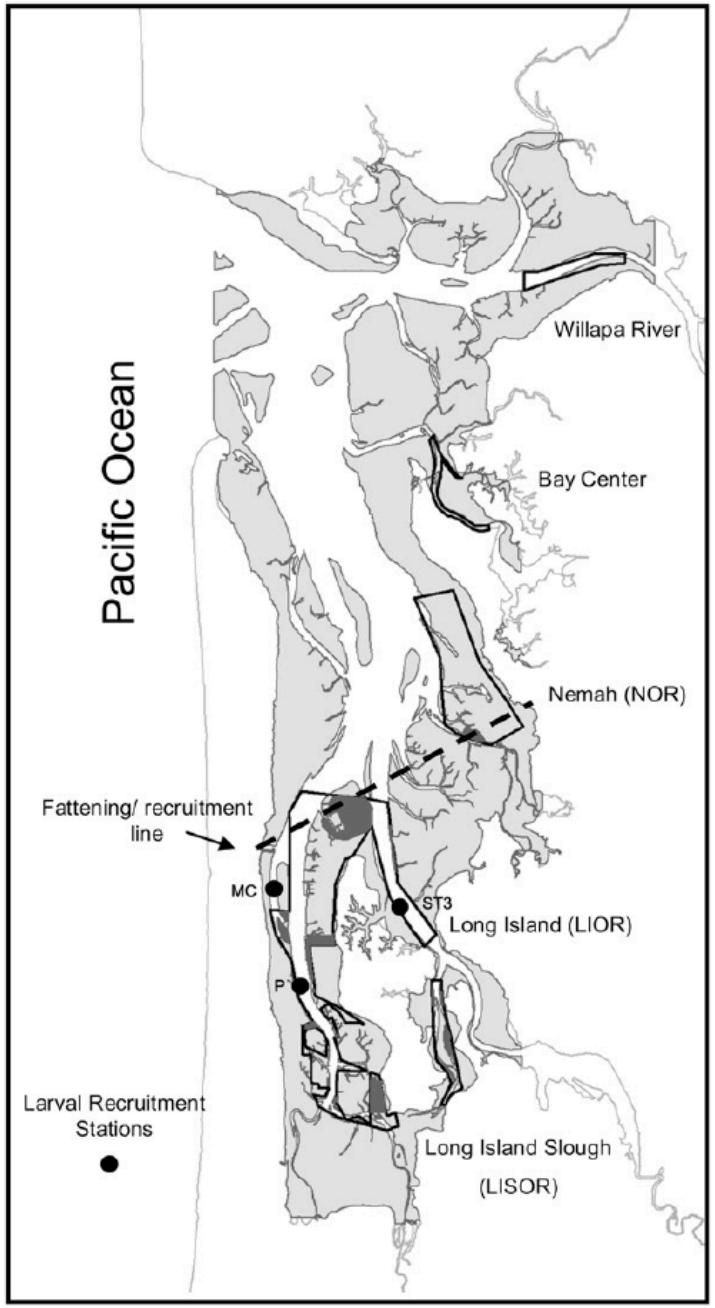
Coastal Upwelling



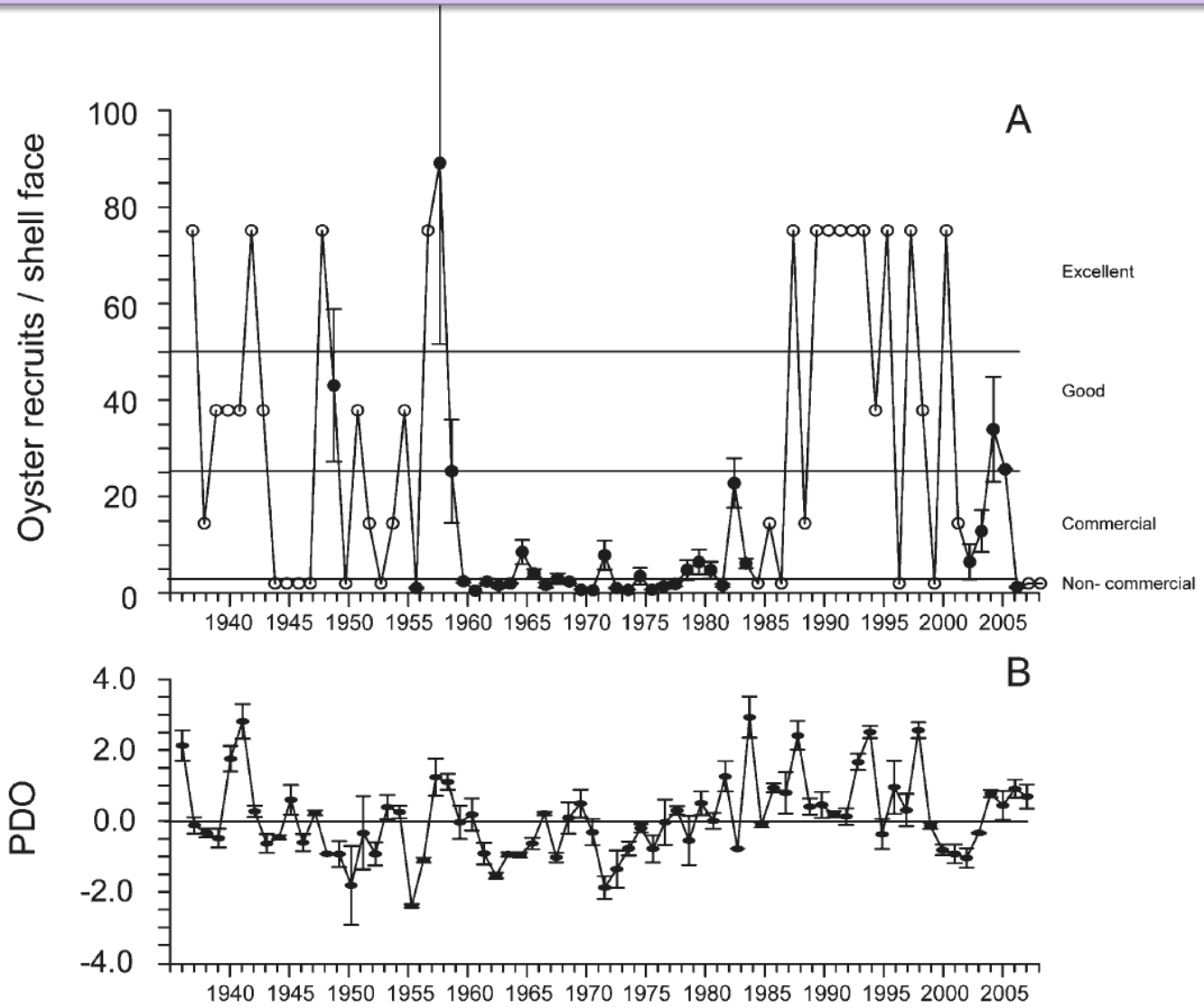
WOCE Nitrate Section: Pacific



1 out of every 8 oysters consumed in the US comes from Willapa Bay!



BUT: Oyster growth in Willapa can be disrupted – especially for larvae

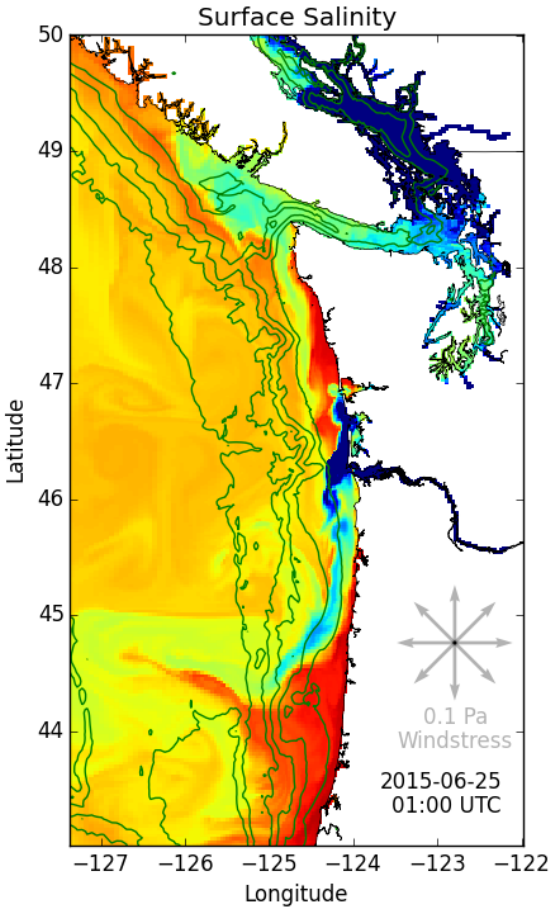


LiveOcean: Overview

- **GOAL**: Provide 3-7 day forecasts of Aragonite saturation state and pH of waters entering shellfish growing areas
- **FUNDING**: Washington Ocean Acidification Center
- **STRATEGY**: Build on existing 3D circulation-biogeochemistry hindcast models of the WA coast and Salish Sea, incorporating carbon chemistry
- **RESULTS SO FAR**:
  - Model is currently creating 3-day forecasts of currents, temperature, salinity, NPZDO+Carbon.
  - Model physics and biogeochemistry validation with 2013-15 hindcast
  - Physics forecasts available daily through NANOOS NVS

LiveOcean Model Configuration

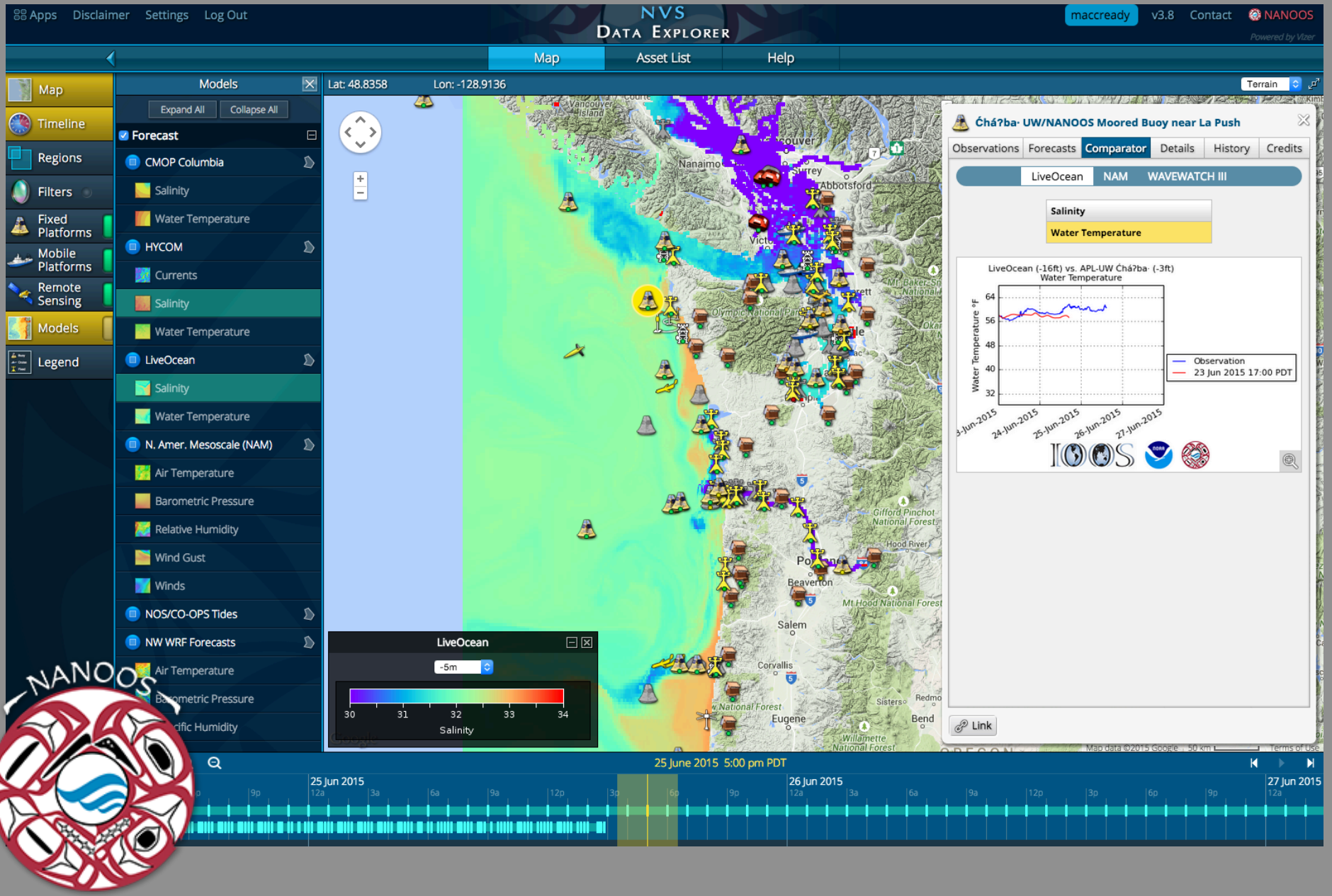
- ROMS (Regional Ocean Modeling System)
- Domain: OR-WA-BC Coast and Salish Sea
- Realistic tides, winds, rivers, and open ocean
- Horizontal grid: 1.5 km on coast
- 40 vertical layers
- Run daily on 72 cores:
  - takes 1.5 hours for 3 days of model time
- Full 3D fields stored hourly and sent to cloud storage using Microsoft Azure, simplifying access
- Web front-ends developed by NANOOS



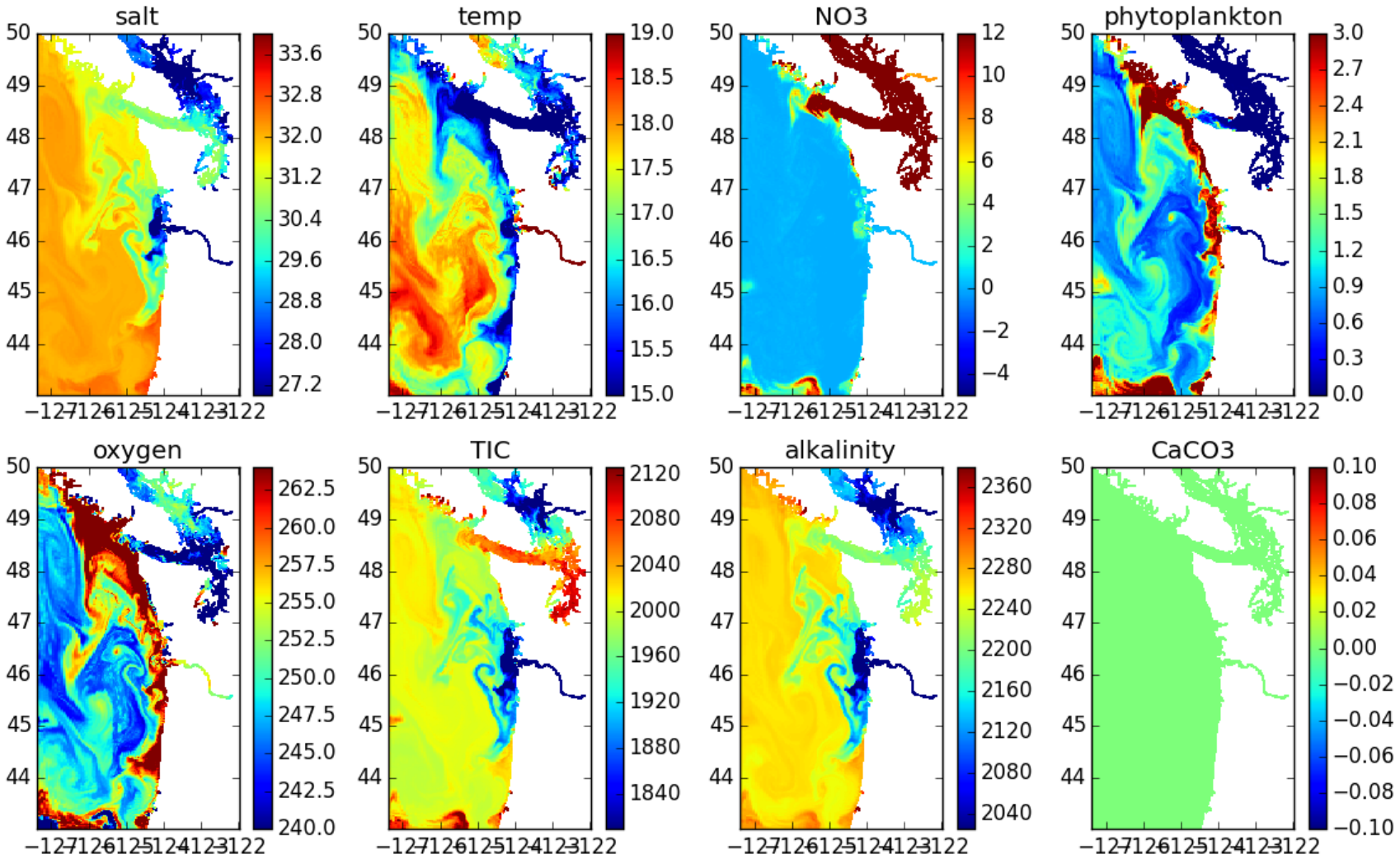
Forcing

- **Atmosphere**: Hourly wind stress and heat fluxes from WRF 12 km Regional Forecast – Cliff Mass UW (4 km and better also available) [+3.5 days]
- **Ocean**: Daily currents, temperature, salinity, sea surface height from HYCOM (Global, Data-assimilative, hycom.org) [+8 days]
- **Rivers**: 15 in Salish Sea + Columbia River, from USGS, Environment Canada and NOAA Northwest River Forecast Center, scaling factors from Ecology [+10 days]
- **Tides**: 8 constituents from TPXO7.2 Inverse Global Tidal Model (Egbert & Erofeeva 2002) [arbitrary time using nodal corrections]

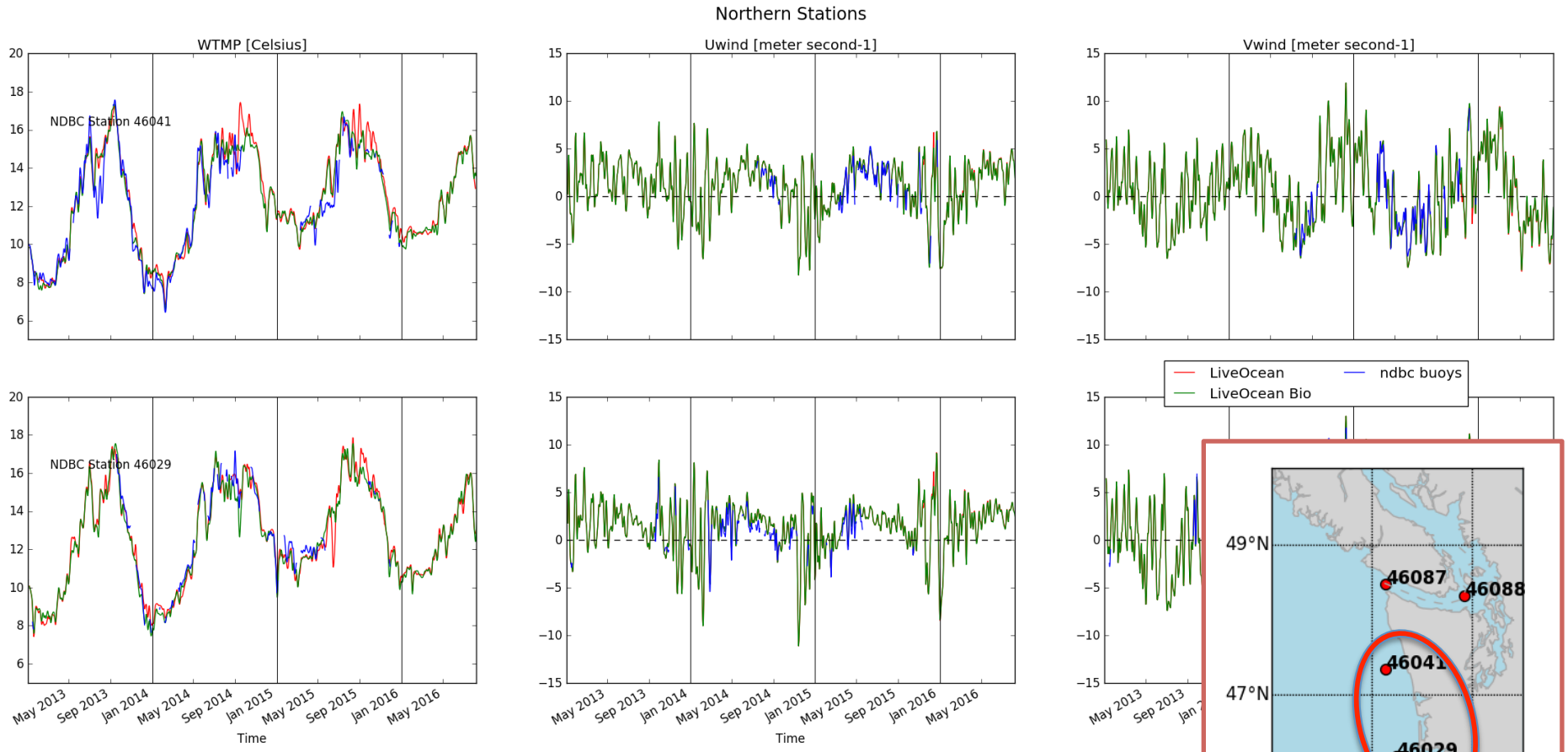
3-Day forecast appears daily on NANOOS NVS

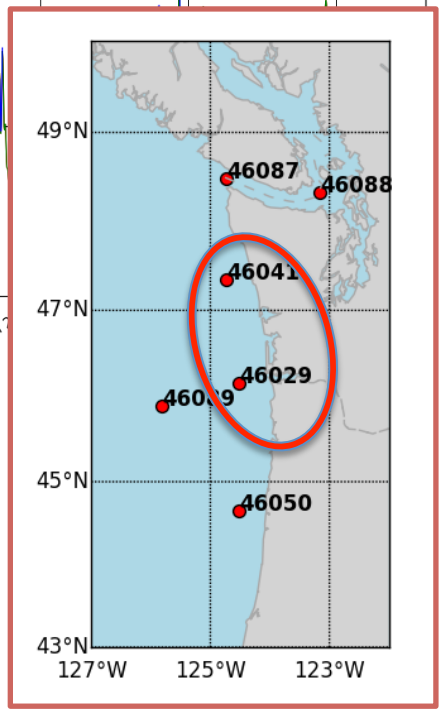


LiveOcean Biogeochemical Fields



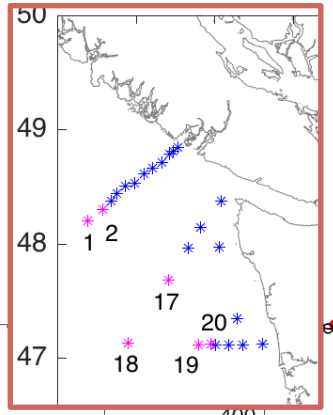
Validation: NDBC Buoys

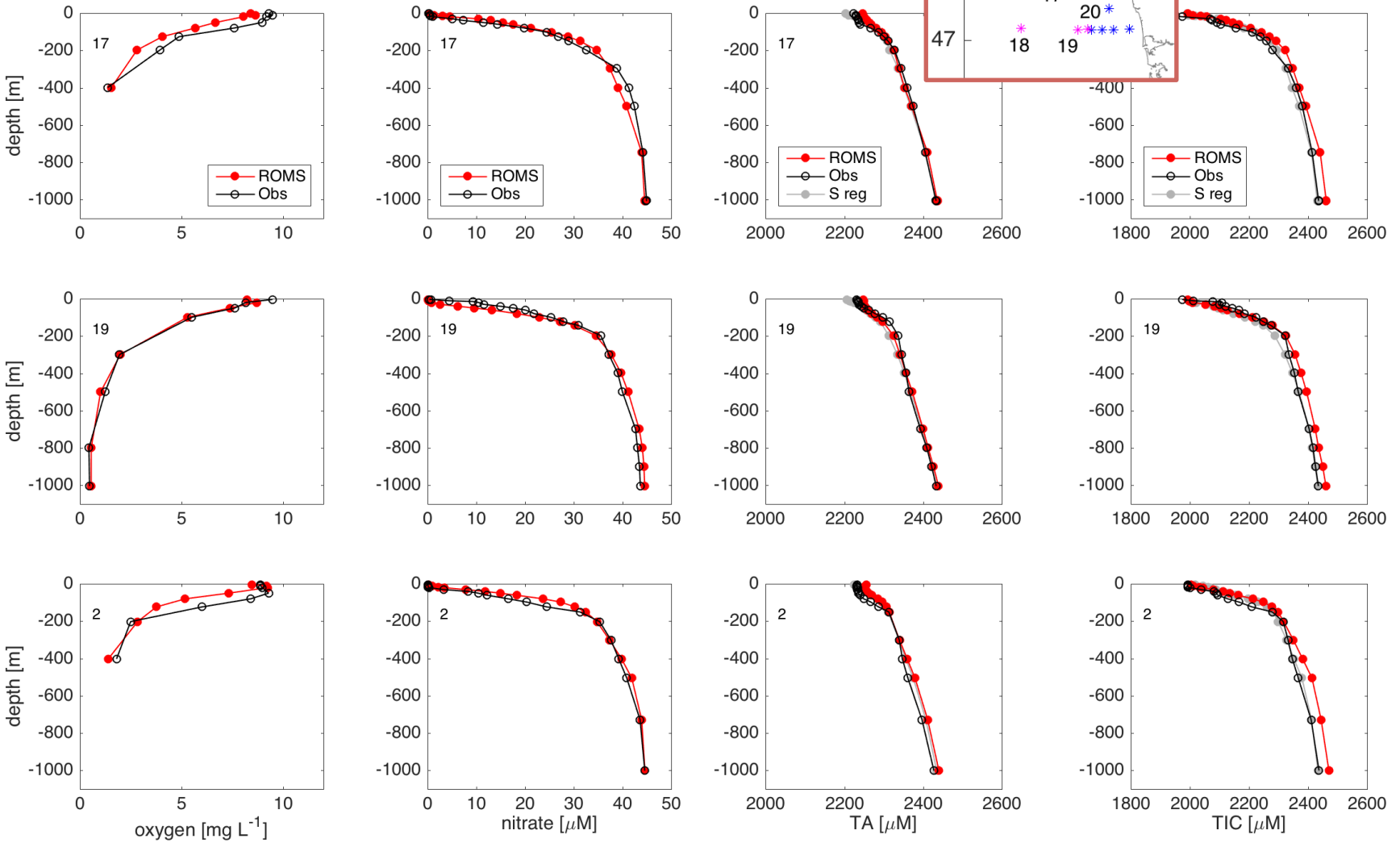




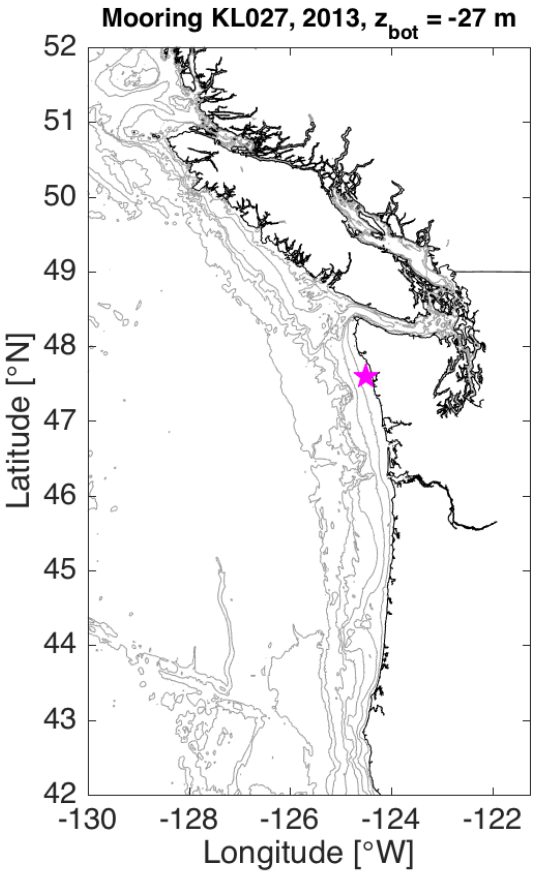
The Blob... returns!

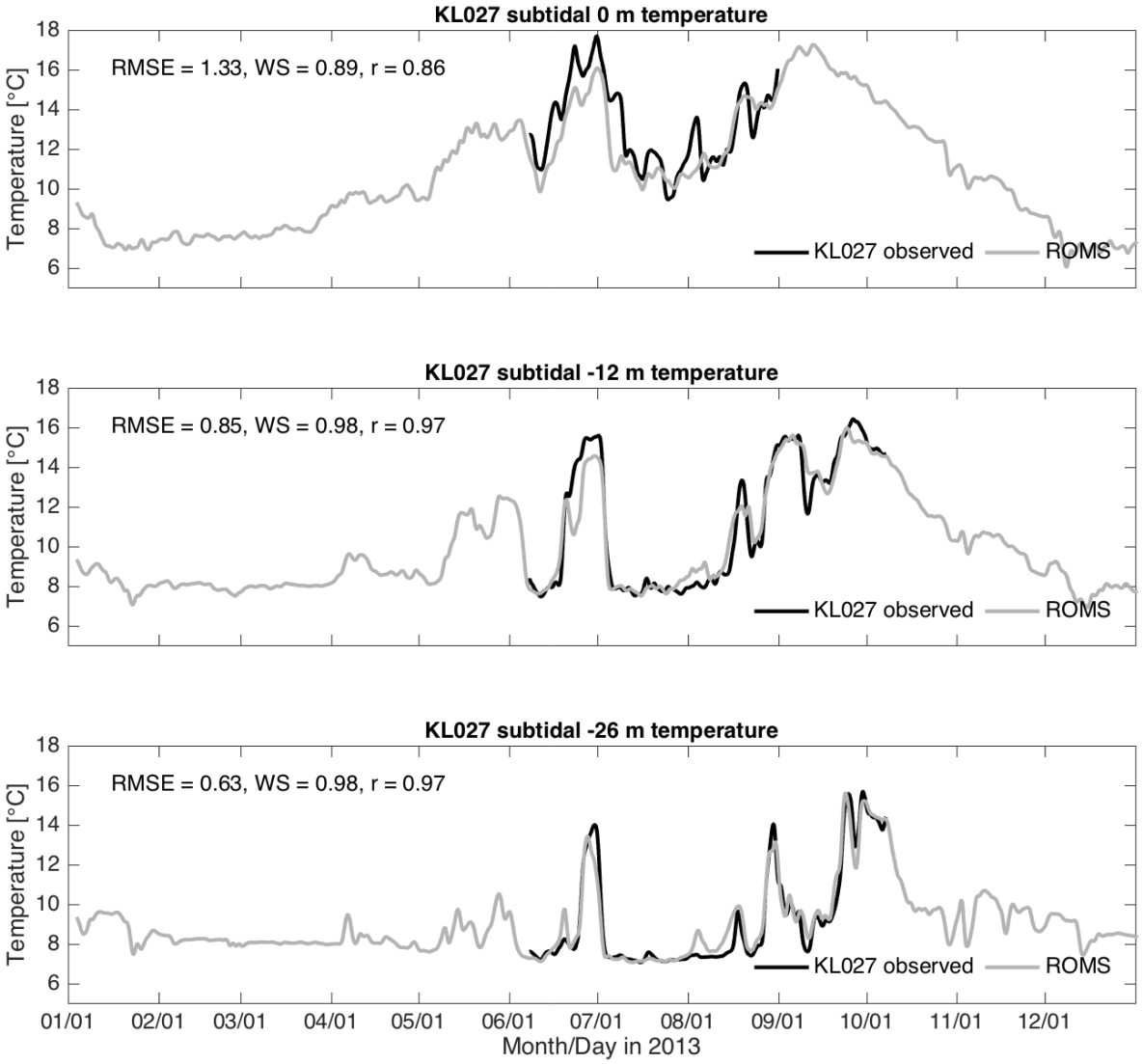
Validation: NOAA Casts 2013



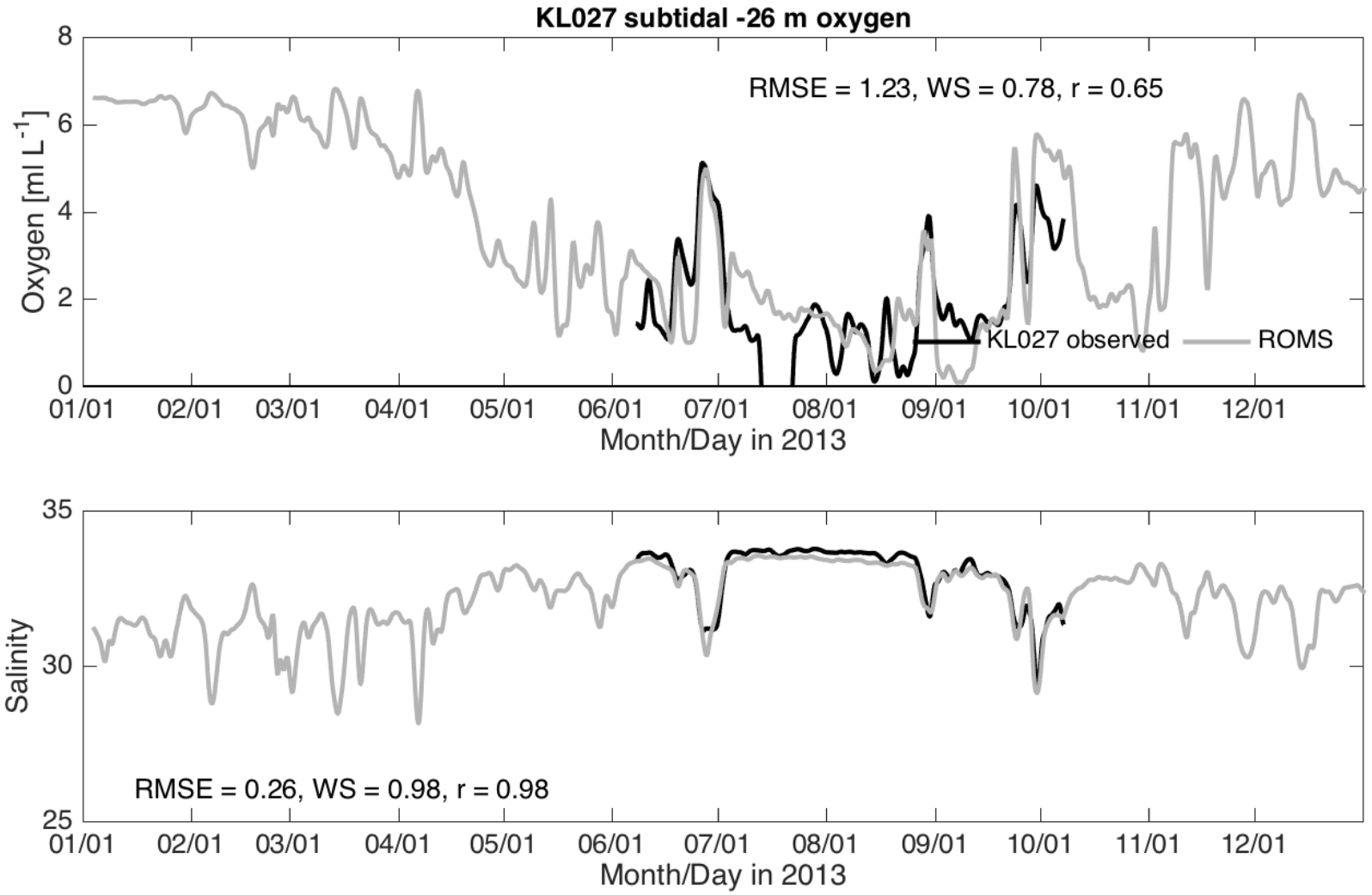


Validation: OCNMS Mooring



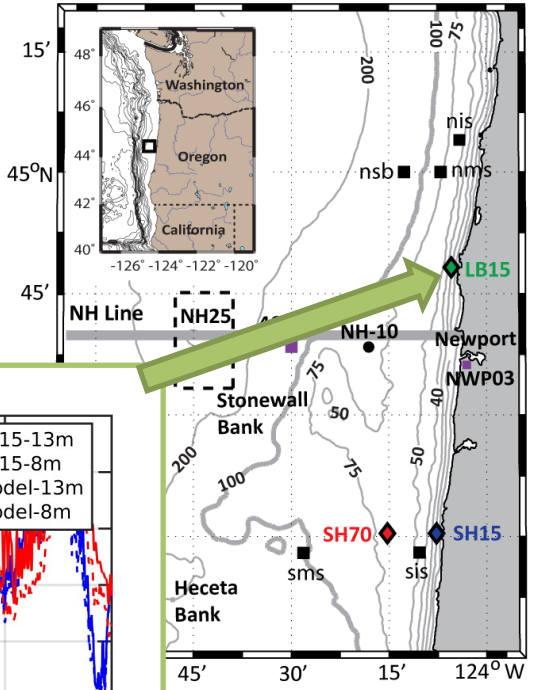


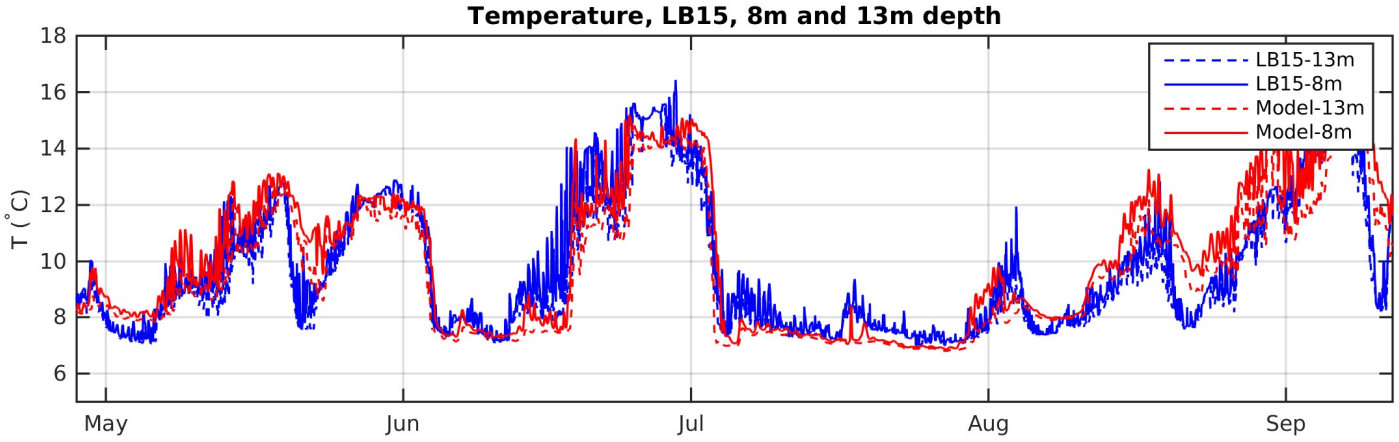
Validation: OCNMS Mooring DO, salt

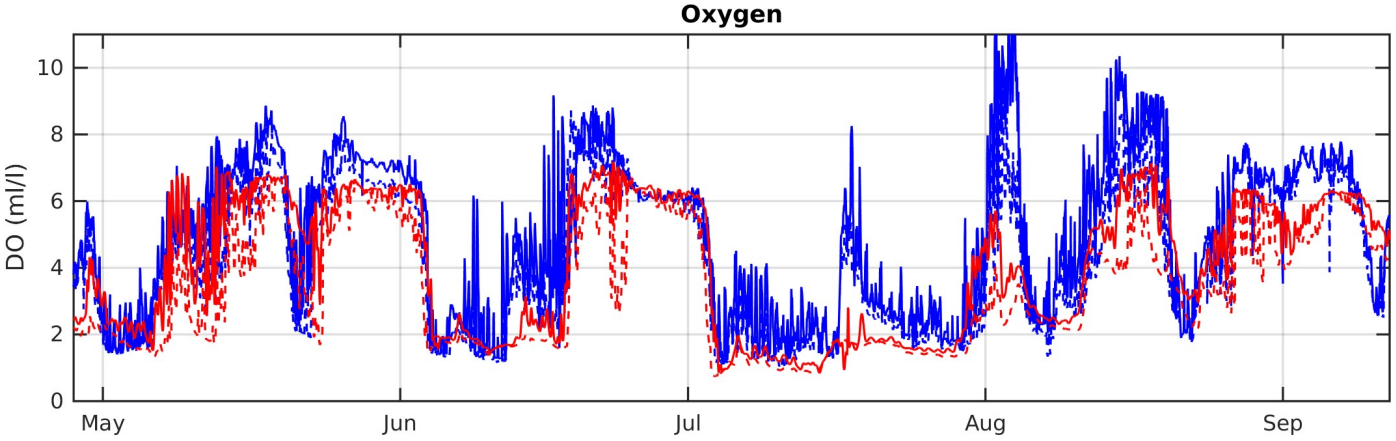


Validation: Shallow Mooring

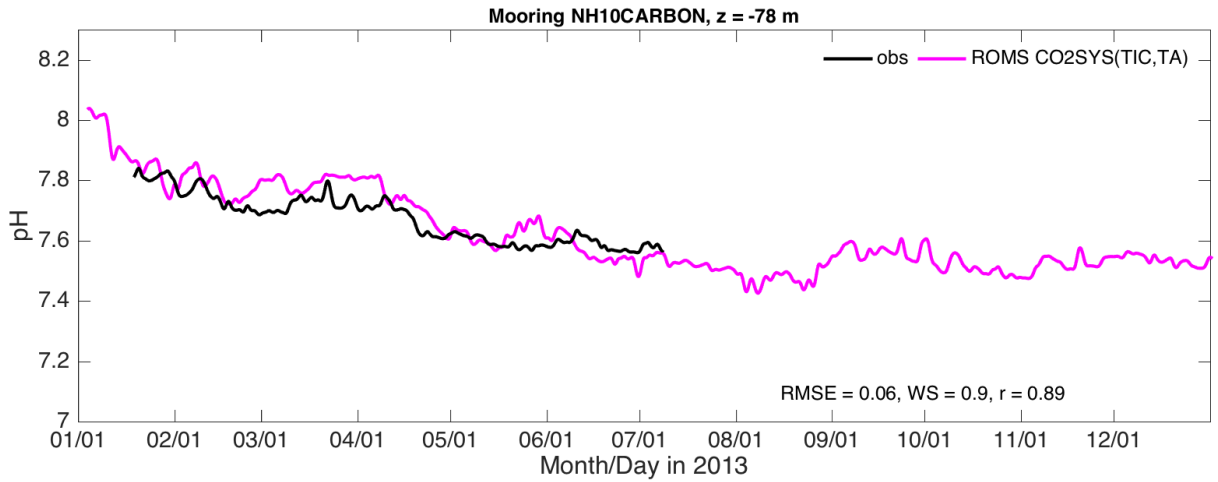
Barth, Durski, & Chan at OSU

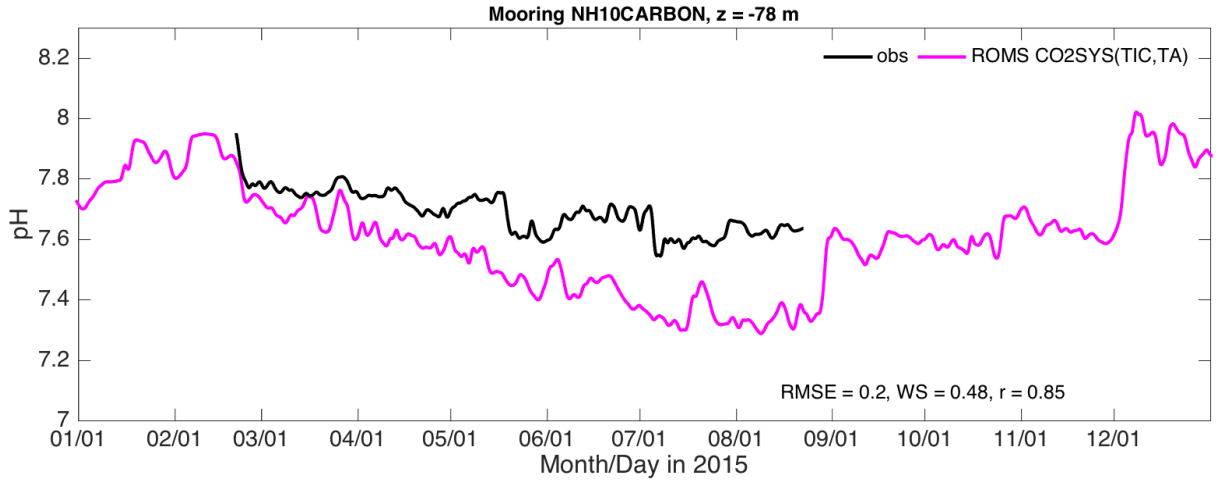


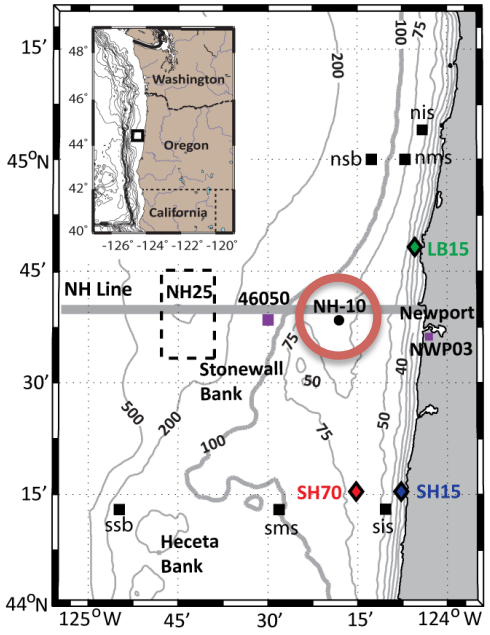




Validation: Mid-Shelf pH

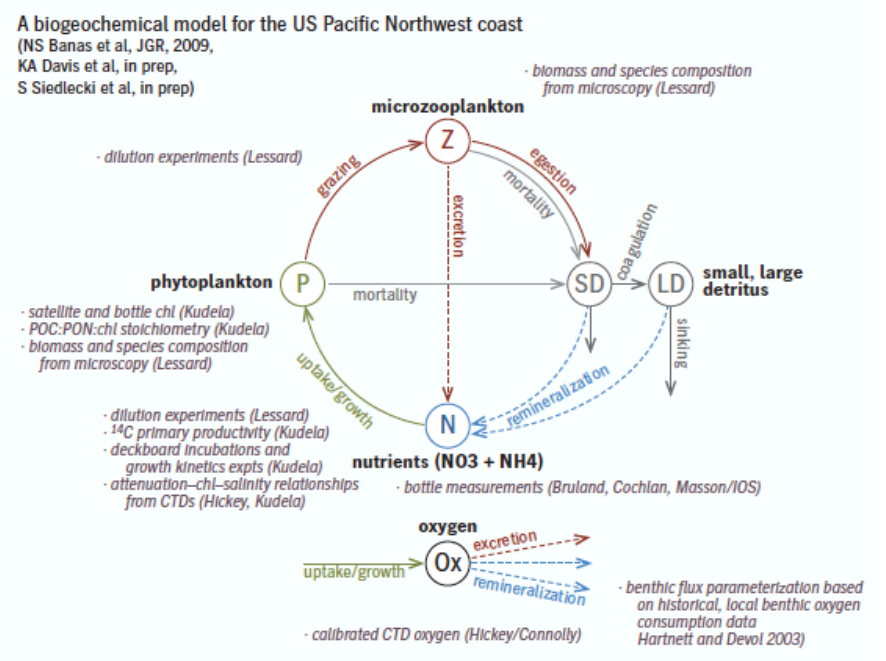


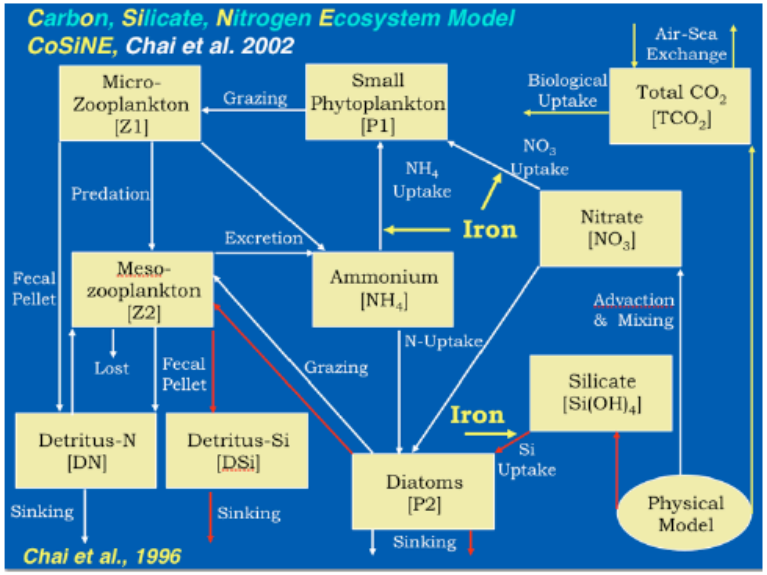


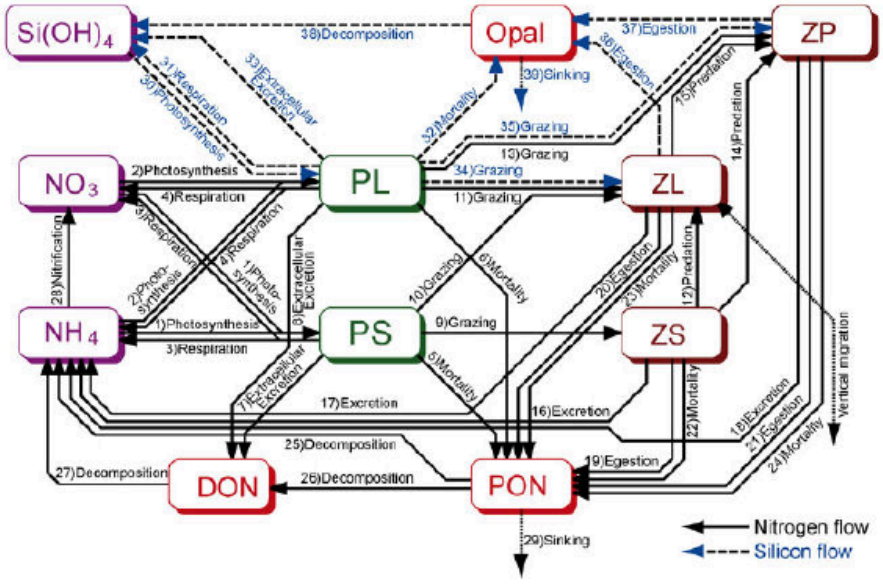


Coastal Ocean Model Testbed

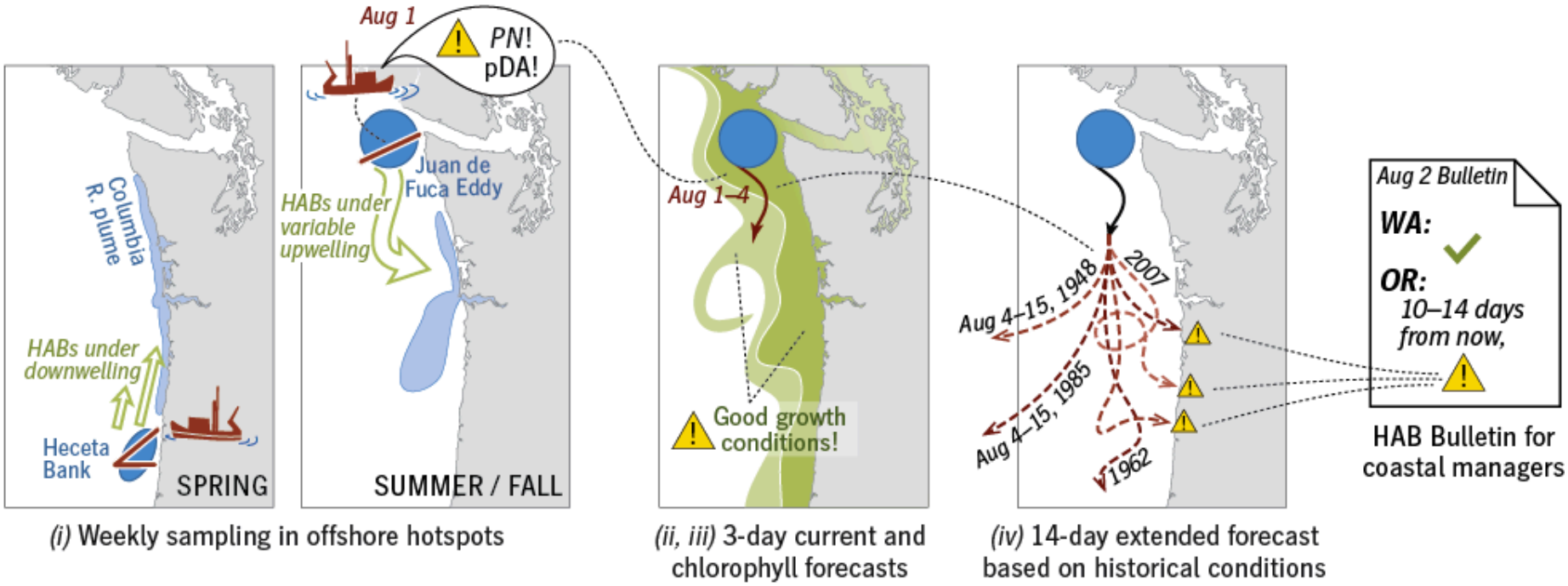
- Cascadia (Banas)
- CoSiNE (Chai)
- NEMURO (Edwards)







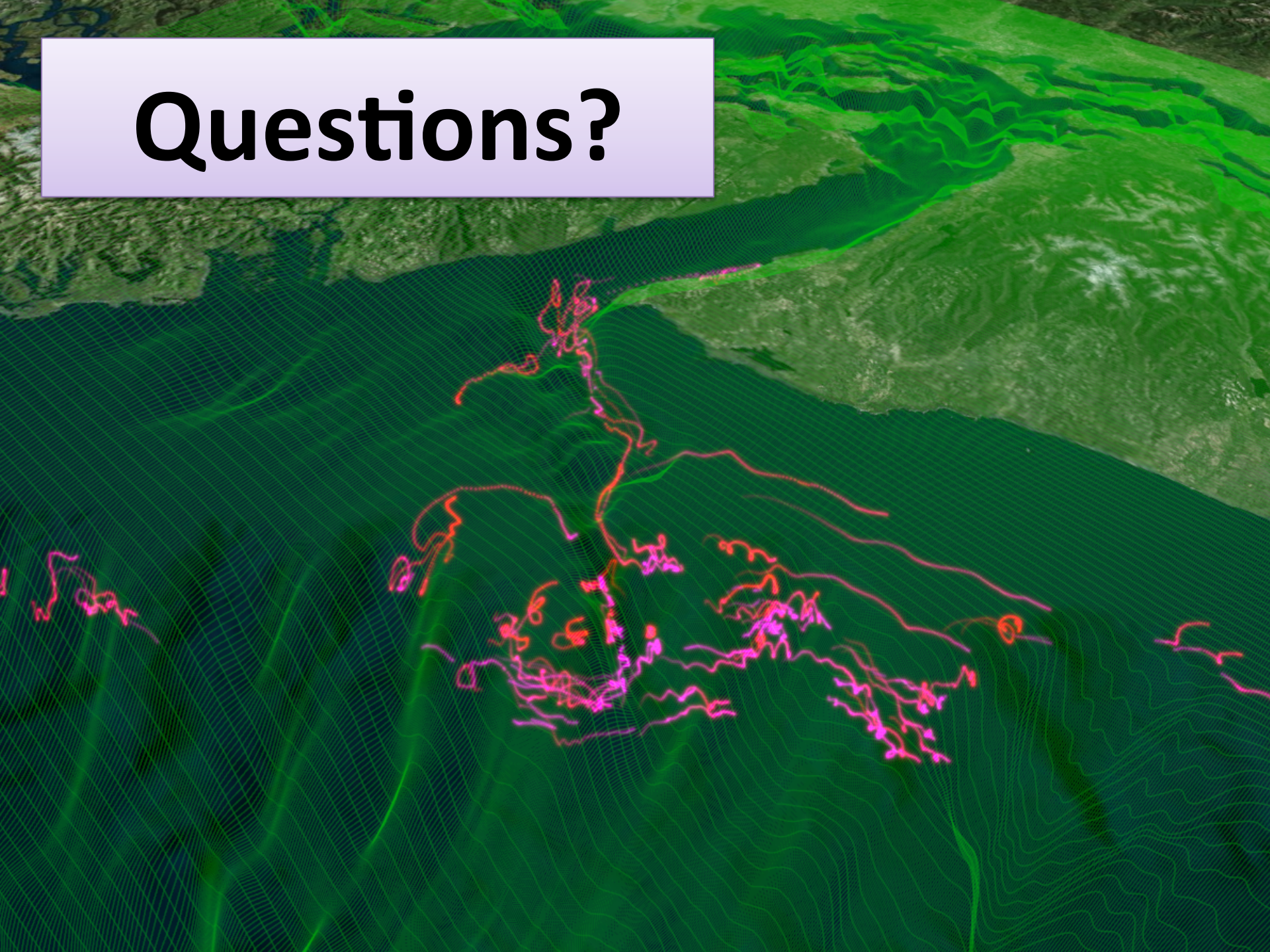
MERHAB PNW: An early warning system for Pseudo-nitzschia HABs on Pacific Northwest outer-coast beaches



(i) Weekly sampling in offshore hotspots

(ii, iii) 3-day current and chlorophyll forecasts

(iv) 14-day extended forecast based on historical conditions


Questions?